

We Claim:

1. A method for exposing an object to fluid, comprising the steps of:  
5 introducing the object into a coanda flow forming passage, the coanda flow forming passage including an interior and a wall surrounding the interior, the wall having a coanda profile; and  
directing a first fluid, onto the coanda profile to induce coanda flow through the passage.

10 2. The method of claim 1 wherein:  
the coanda flow forming passage includes an upstream opening, and  
the directing step causes an atmosphere exterior of the upstream opening to be entrained by the coanda flow and drawn through the coanda flow forming  
15 passage.

20 3. The method of claim 2 wherein the method is for drying an object using a mixture of drying fluid and entrained air, and wherein the directing step includes directing a drying fluid onto the coanda profile.

4. The method of claim 3 wherein the drying fluid comprises a gas.

5. The method of claim 4 wherein the gas comprises nitrogen.

25 6. The method of claim 2 wherein the atmosphere comprises ambient air.

30 7. The method of claim 1 wherein the coanda flow forming passage further includes at least one fluid aperture positioned within the coanda flow forming passage, and wherein the method further includes directing a second fluid through the aperture onto the object.

8. The method of claim 7 wherein the second fluid is a cleaning fluid.

9. The method of claim 8 wherein the cleaning fluid comprises water.

10. The method of claim 7 wherein the step of directing a second fluid onto the object is performed prior to the step of directing a coanda jet, comprised of a first fluid, onto the coanda profile to induce coanda flow.

11. The method of claim 10 wherein the second fluid is a cleaning fluid and the first fluid is a drying fluid.

12. The method of claim 11 wherein the cleaning fluid comprises water.

13. The method of claim 11 wherein the drying fluid comprises a gas.

14. The method of claim 13 wherein the gas comprises nitrogen.

15. The method of claim 1 wherein the coanda flow forming passage includes a reduced diameter section and wherein the method further includes the step of accelerating the first fluid and entrained atmosphere through the flow passage by causing the first fluid and entrained atmosphere to flow through the reduced diameter section.

16. A method of treating an object with a fluid, comprising the steps of: providing a chamber comprising a coanda passage having an interior and a longitudinal axis, the interior including a surface curved in a longitudinal direction, the chamber further including a coanda slot or other geometry to produce a coanda jet;

positioning an object within the coanda chamber;

directing a coanda jet, comprised of a first fluid, onto the coanda inducing profile to cause coanda flow through the passage.

17. The method of claim 16 wherein:

5 the coanda passage includes an upstream opening, and  
the directing step causes an atmosphere exterior of the upstream opening to be entrained by the coanda flow and drawn through the coanda passage.

18. The method of claim 17 wherein the method is for drying an object  
10 using a drying fluid, and wherein the directing step includes directing a drying fluid through the coanda slot.

19. The method of claim 18 wherein the drying fluid is a gas.

15 20. The method of claim 19 wherein the gas is nitrogen.

21. The method of claim 17 wherein the atmosphere comprises ambient air.

20 22. The method of claim 16 wherein the coanda passage further includes at least one fluid aperture positioned within the coanda passage, and wherein the method further includes directing a second fluid through the aperture onto the object.

25 23. The method of claim 22 wherein the second fluid is a cleaning fluid.

24. The method of claim 23 wherein the cleaning fluid comprises water.

30 25. The method of claim 22 wherein the step of directing a second fluid onto the object is performed prior to the step of directing a coanda jet, comprised of a first fluid, onto the coanda profile to induce coanda flow.

26. The method of claim 25 wherein the second fluid is a cleaning fluid and the first fluid is a drying fluid.

27. The method of claim 26 wherein the cleaning fluid comprises water.

28. The method of claim 26 wherein the drying fluid comprises a gas.

29. The method of claim 28 wherein the gas comprises nitrogen.

30. The method of claim 16 wherein the coanda flow forming passage includes a reduced diameter section and wherein the method further includes the step of accelerating the first fluid and entrained atmosphere through the flow passage by causing the first fluid and entrained atmosphere to flow through the reduced diameter section.

31. An apparatus for treating an object with fluid, comprising:  
a chamber having an interior proportioned to receive an object to be treated, the chamber enclosed by a wall having a coanda profile, the wall defining a chamber interior;  
a fluid inlet fluidly coupled to the interior of the chamber; and  
the coanda profile configured to cause fluid passed through the fluid inlet onto the coanda profile to form a coanda flow of fluid through the chamber.

32. The apparatus of claim 31, wherein the coanda profile is further configured to cause the fluid to entrain an atmosphere to cause a mixture of fluid and entrained atmosphere to flow through the interior.

33. The apparatus of claim 31 further including a fluid aperture positioned in the interior of the chamber.

34. The apparatus of claim 33 further including a second fluid inlet, wherein the fluid aperture is fluidly coupled to the second fluid inlet.

35. The apparatus of claim 31 wherein the forming means includes a  
5 coanda slot fluidly coupled to the first fluid inlet and formed in a portion of the chamber, and a longitudinally curved interior wall within the chamber interior.

36. The apparatus of claim 35, wherein the forming means further includes at least one arcuate passage fluidly coupled between the first fluid inlet  
10 and the coanda slot.

37. An apparatus for treating an object with fluid, comprising:  
a chamber having an interior proportioned to receive an object to be treated, the interior surrounded by a wall curved in a longitudinal direction;  
15 a fluid inlet fluidly coupled to the interior of the chamber; and  
a coanda slot fluidly coupled between the fluid inlet and the chamber interior.

38. The apparatus of claim 37 wherein the interior wall and coanda slot  
20 are proportioned to cause a coanda flow through the interior of the chamber when fluid is directed into the fluid inlet.

39. The apparatus of claim 38 wherein the chamber includes an upstream opening, and wherein the interior wall and coanda slot are further  
25 proportioned to cause fluid directed into the chamber from the fluid inlet to entrain an atmosphere through the upstream opening to cause a mixture of fluid and entrained atmosphere to flow through the interior.

40. The apparatus of claim 37 further including at least one fluid  
30 aperture positioned in the interior of the chamber.

41. The apparatus of claim 40 further including a second fluid inlet, wherein the fluid aperture is fluidly coupled to the second fluid inlet.

42. The apparatus of claim 37 further including at least one arcuate  
5 passage fluidly coupled between the first fluid inlet and a coanda slot.

43. The apparatus of claim 39 wherein the interior of the chamber has a reduced-diameter section and wherein the fluid aperture is positioned downstream of the reduced-diameter section.

44. The apparatus of claim 43, wherein the interior of the chamber has a flared section downstream of the reduced-diameter section, and wherein the fluid aperture is positioned in the flared section.

45. An apparatus for treating an object with fluid, comprising:  
a chamber having an upstream opening and a downstream opening, and an interior between the upstream and downstream openings, the interior including a longitudinal axis and a curved surface at an upstream end of the chamber, the interior proportioned to receive an object to be treated with fluid;  
a fluid inlet coupled to the chamber;  
a coanda slot fluidly coupled between the fluid inlet and the chamber interior, the coanda slot oriented to have a flow direction transverse to the longitudinal axis of the chamber interior such that fluid passing through the coanda slot, onto the coanda profile, and into the interior of the chamber entrains air through the upstream opening and mixes with the entrained air as it moves downstream within the chamber.

46. The apparatus of claim 45, further including:  
at least one annular channel fluidly coupled between the fluid inlet and the coanda slot.

47. The apparatus of claim 45, wherein the curved surface curves inwardly to form a reduced-diameter section of the chamber.

5 48. The apparatus of claim 47, further including a flared section in the chamber downstream of the reduced-diameter section.

49. The apparatus of claim 50, further including at least one fluid aperture in the chamber.

10 50. The apparatus of claim 49, further including a flared section in the chamber downstream of the curved section, the fluid aperture positioned in the flared section.

15 51. The apparatus of claim 45 wherein the fluid inlet is connected to a source of drying fluid.

52. The apparatus of claim 51 wherein the drying fluid is a gas.

20 53. The apparatus of claim 52 wherein the gas is nitrogen

54. The apparatus of claim 52 further including at least one fluid aperture in the chamber, the aperture coupled to a source of cleaning fluid.

25 55. The apparatus of claim 53 wherein the cleaning fluid comprises water.